University of Nebraska at Omaha
DigitalCommons@UNO

Student Work

9-1-1976

Peer Tutoring to Increase Mathematics Performance: An Examination of Generalized Changes in Classroom Behavior.

Malinda Lee McKenzie

Follow this and additional works at: https://digitalcommons.unomaha.edu/studentwork

Recommended Citation
McKenzie, Malinda Lee, "Peer Tutoring to Increase Mathematics Performance: An Examination of Generalized Changes in Classroom Behavior." (1976). *Student Work*. 3536.
https://digitalcommons.unomaha.edu/studentwork/3536

This Thesis is brought to you for free and open access by DigitalCommons@UNO. It has been accepted for inclusion in Student Work by an authorized administrator of DigitalCommons@UNO. For more information, please contact unodigitalcommons@unomaha.edu.

UNIVERSITY LIBRARY
UNIVERSITY OF NEBRASKA AT OMAHA

Peer Tutoring to Increase Mathematics Performance: An Examination of Generalized Changes in Classroom Behavior

A Thesis
Presented to the
Department of Psychology
and the
Faculty of the Graduate College
University of Nebraska

In Partial Fulfillment
of the Requirements for the Degree
Master of Arts
University of Nebraska at Omaha

by
Malinda Lee McKenzie
September, 1976

UMI Number: EP74734

All rights reserved

INFORMATION TO ALL USERS
The quality of this reproduction is dependent upon the quality of the copy submitted.

In the unlikely event that the author did not send a complete manuscript
and there are missing pages, these will be noted. Also, if material had to be removed,
a note will indicate the deletion.

UMI EP74734

Published by ProQuest LLC (2015). Copyright in the Dissertation held by the Author.

Microform Edition © ProQuest LLC.
All rights reserved. This work is protected against
unauthorized copying under Title 17, United States Code

ProQuest LLC.
789 East Eisenhower Parkway
P.O. Box 1346
Ann Arbor, MI 48106 - 1346

THESIS ACCEPTANCE

Accepted for the faculty of the Graduate College, University of Nebraska, in partial fulfillment of the requirements for the degree Master of Arts, University of Nebraska at Omaha.

Thesis Committee

Name	Department
J. Michael Lehmann	
Norman N. Hamm	
William G. Callahan	

Karen Budd
Chairperson

8·25·76
Date

Table of Contents

Acknowledgements

I wish to thank Drs. Karen Budd, J. Michael Leibowitz, Norman Hamm and William Callahan for serving as members of my thesis committee. Each member provided suggestions and insights that were helpful and constructive. A special thanks is extended to Dr. Karen Budd who served as major advisor and supervisor throughout the study. Her assistance in organizing the study and preparing the final manuscript is greatly appreciated. I would also like to thank the Research Department of the Omaha Public School System for allowing me to conduct the study in one of their schools. An additional expression of gratitude goes to Patricia K. Shehan and Dorothy Woodall. Pat's ideas and suggestions were invaluable. Dorothy allowed me to observe her class and extended considerable support.

Abstract

A peer-tutoring package was implemented to improve the accuracy of mathematics performance of two students, aged 11 and 14 years, in an engineered school classroom. A reversal design was employed to evaluate the effectiveness of peer tutoring for one student, with subsequent extension of the tutoring package to the second student. Examinations were made of changes in accuracy as a result of tutoring, as well as the correlated effects of treatment on on-task and disruptive behavior. Investigations were also conducted of the generalized effects of treatment to another math period (with similar problems) in which tutoring was never implemented, differentiated between days of tutor presence and tutor absence. The tutoring package significantly improved academic performance in both students, with desired changes observed in the correlated behaviors. Improvements also occurred in the generalization period, with no noticeable differences in performance as a function of the tutor's presence or absence.

Peer Tutoring to Increase Mathematics Performance: An Examination of Generalized Changes in Classroom Behavior

A wide variety of behavior modification procedures have been employed successfully in school classrooms to decrease disruptive student behaviors (e.g., Broden, Bruce, Mitchell, Carter, & Hall, 1970; Hall, Panyan, Rabon, & Broden, 1968; Thomas, Becker, & Armstrong, 1968), improve compliance with school rules (e.g., Jones & Eimbers, 1975) and enhance academic performance (e.g., Lovitt & Curtis, 1969). The procedures most frequently used are social attention (e.g., Chadwick & Day, 1971), token economies (e.g., O'Leary, Becker, Evans, & Saudargas, 1969), and timeout (e.g., Clark, Rowbury, Baer, & Baer, 1973; Lahey, McNees, & McNees, 1973; Wasik, Senn, Welch, & Cooper, 1969). These procedures have been employed in both individual (e.g., Osborne, 1969; Williams & Anandam, 1973), and group programs (e.g., Barrish, Saunders, & Wolf, 1969; Harris & Sherman, 1973b; Medland & Stachnik, 1972; Packard, 1970). Most of these procedures have been carried out by the regular classroom teacher, or occasionally by a teacher aide; however, it is sometimes difficult for teachers to act efficiently in applying behavioral techniques because of their diverse responsibilities in the classroom.

An alternative approach to classroom management that shows considerable promise involves utilizing peers as

treatment agents for their own classmates. This technique can result in more efficacious use of teacher time by freeing teachers from routine responsibilities while at the same time teaching the students appropriate procedures for interacting with each other in the classroom. Peer managers have often been enlisted to help in reducing disruptive behaviors of classmates. For example, Lovitt, Lovitt, Eaton, and Kirkwood (1973) decelerated the frequency of vulgar remarks in a nine-year-old boy by training a peer within a special education class to systematically ignore such comments. Solomon and Wahler (1973) decreased disruptive behaviors (talking out, out-of-seat, etc.) in a group of sixth grade students by training five peer managers to refrain from reacting to such behaviors by their classmates. A fifth grader was taught by Surratt, Ulrich, and Hawkins (1969) to record and reinforce the working activities in four first-grade students who had previously displayed disruptive and unruly behavior and minimal study habits; there was a significant increase in on-task performance after the student engineer was assigned the duty of monitoring their working. Long and Madsen (1975) found that children as young as five could be trained to control unruly behavior in three-year-olds.

Peers have also functioned as tutors to increase academic performance in their classmates. Peer tutors have improved accuracy in fourth and fifth grade students'

performance on math problems (e.g., Harris & Sherman, 1973a). Stokes and Baer (1976b) successfully trained a six-year-old child to teach work recognition skills to his classmate. Articulation errors were corrected in a 13-year-old male by using peers to reinforce appropriate speech (e.g., Bailey, Timbers, Phillips, & Wolf, 1971). Similarly, Johnston and Johnston (1972) were successful in modifying consonant speech sounds in six-year-old boys and girls by teaching their friends to respond only to the correct sounds.

Thus, previous studies have documented the effectiveness of peers as treatment agents for their classmates' behavior. However, one area that has received little systematic investigation concerns the correlated effects of the peer-treatment program on other important classroom behaviors that were not directly treated. Even studies employing the teacher as the treatment agent have typically focused on either academic performance or on disruptive or on-task behavior, rather than examining concurrent effects across these two dimensions of classroom behavior. In one of the few studies directly aimed at examining this relationship, Ayllon and Roberts (1974) found a consistent reduction in disruptive behavior in five target subjects as a result of improving reading performance through a token reinforcement system; these investigators did not report whether or not any correlated changes occurred in on-task behavior. On the other hand,

Ferritor, Buckholdt, Hamblin and Smith (1972) found that contingencies which increased attending and decreased disruptive responses had no effect on academic performance; and, conversely, consequences that improved academic responses did not improve attending, and appeared to increase disruptive behavior. These conflicting results, along with paucity of information in the literature regarding this relationship, point to the need for further research to investigate the concurrent effects of peer-treatment programs on other untreated behaviors.

Another area that has received little study concerns the generalized effects of peer tutoring on student performance in other periods of the day, when the treatment program is not in effect. Stokes and Baer (1976a), in their review of the research literature on generalization, suggest that children's peers provide a common stimulus in both training and nontraining settings that could act as a discriminative stimulus for generalized responding across settings. Evidence of this discriminative role of peers was suggested in a study by Johnston and Johnston (1972) who employed peers to monitor each other's articulation of speech sounds, and found that the students generalized their correct articulation to another setting only when the monitoring peer was present in that setting. It was not clear, however, whether the observed generalization resulted from a discriminative effect of the peers' presence or from active monitoring by the peers in the generalization setting. This question was

pursued by Stokes and Baer (1976b), who trained a word recognition skill in a non-training setting in the absence of the peer tutor; however, generalized effects were seen in the tutor's presence, even when no interaction occurred between the target subject and tutor. This evidence of the generalization-facilitating role of peers suggests a potentially important advantage of utilizing peers as treatment agents. Because of the highly experimental nature of the settings used by Stokes and Baer, the generalized effects of peer-treatment programs need further research in a more naturalistic classroom setting.

The purpose of the present study was threefold: (1) to examine whether the use of a peer manager could result in increased accuracy of performance on a mathematics task by two target children, (2) to determine if appropriate study behaviors increased and disruptive responses decreased as a function of improving academic skills, and (3) to examine what effect, if any, the presence or absence of the manager had in facilitating generalization of increased levels of accuracy and other desired behaviors from the treatment period to a second period in which no treatment was implemented.

Method

Subjects

The study was conducted in an engineered classroom for children with learning and/or behavior problems in the Omaha Public School System. The students in the class ranged

from 8 to 14 years of age, and had been referred from a regular classroom because of difficulties in complying with the requirements in a normal class. Six of the students had been under psychiatric care and several were on medication to control hyperactivity. Most of the students manifested high rates of talking out, pencil tapping, out-of-seat, non-compliance, inattentiveness, and disrupting others. They all functioned below academic standards established for their particular age groups. The enrollment figure in the class fluctuated because of the tenuous adjustments of several children who were added to and dropped from the roster for varying reasons; the mean number of students was eight. There was one teacher and one aide responsible for educational instruction.

Three subjects participated in the study: two target subjects, Sam and Kathy, and the peer manager, Randy. Sam, an 11-year-old male, was placed in the special education classroom primarily because of behavioral problems, but he also functioned below average academically and was diagnosed as functioning in the low average range of intelligence. His behavior was frequently disruptive and included making faces at others, excessive out-of-seat, pencil tapping, and some aggressiveness in the form of pushing and shoving classmates. Social interaction was mostly negative for Sam, and appropriate cooperative play was seldom observed. The teacher recommended him as a target subject because (1) he needed improvement in division skills, (2) he needed improvement in on-task behaviors,

and (3) his attendance was regular. Although he usually completed assignments, accuracy was poor and erratic.

Kathy, a 14-year-old female, was the second target subject in the study. She had been diagnosed as educationally mentally handicapped and frequently required individual instruction. Her disruptive behaviors consisted of silly, inappropriate giggling, out-of-seat, and talking out. She was enrolled late in the school year, and thus observation of her behavior began six weeks after the study was initiated with Sam. Kathy had been moved from one school to another and had failed to make a successful adjustment. Her selection to participate was based on the same criteria as those for Sam. She too was experiencing a great deal of difficulty performing on division problems.

Randy, a 12-year-old male, served as the peer manager (or tutor). He had been placed in the class two years prior to the study because of emotional problems, manifesting withdrawal from social interaction with other students and a lethargic attitude toward school work. Psychological reports indicated that he was dull normal in intellectual abilities. The past year he had become more responsive and had begun to help the teacher on his own initiative with some of the younger students. He was chosen to participate because of (1) good math skills, (2) willingness to help others, and (3) a good attendance record. Randy was in the process of being mainstreamed back into the regular class, and two days of the week he attended another class for math

instruction.

The teacher and experimenter felt that all of the subjects would benefit from an interaction situation that presented appropriate ways of communicating positive and negative feedback. Although other children presented problems in need of remediation, these subjects were chosen because of regular school attendance.

Setting and Activities

One target student, Sam, was seated at the far right of the class in the front row of desks, with Randy, the peer manager, seated directly adjacent to Sam on the left. Kathy, the other target subject, was seated two rows behind and one seat to the left of Randy. Because of the small number of pupils in the class, Randy could shift his attention between target students without disturbing others.

The school day was divided into approximately 10 periods, during which the children worked on individually paced assignments in various academic areas. Experimental observations were conducted on school day afternoons (except Tuesday) during two math periods, each lasting between 10 and 20 minutes and separated by a language arts or gym period of approximately 20 minutes.

During the first afternoon math period, all three subjects were present in the room daily. This period was designated the Treatment Period, because the peer-tutoring procedures were implemented in this period during some

phases of the study. During the second math period, both target subjects were present daily; however, the peer manager was out of the room on two of the four observation days each week (specifically, on Mondays and Wednesdays) to receive math instruction in a regular classroom. This period was designated the No Treatment Period because peer tutoring was never directly introduced in this setting. During the Treatment Period, observations were conducted on both target students' behavior, whereas during the No Treatment Period only one target subject, Sam, was observed.

During both math periods each day, the target subjects worked on division problems. Division provided rehersal in addition, subtraction and multiplication. Initially, the task presented to Sam consisted of problems taken from a folder compiled by a teacher aide from the previous year. However, the level of difficulty and number of problems assigned for each math period varied to such an extent that it was not possible to determine consistency of performance. Therefore, beginning on Day 4 of Baseline, daily assignments were taken from a series developed by the McCormick-Mathers Mathematics Laboratory (Tucker & Wheeler, 1970), along with supplemental problems of the same nature and level of difficulty. Sam's beginning assignments consisted of problems taken from the Level 3 (Red) cards and gradually increased in level of difficulty. These items involved 3 digits divided by 1 digit. Kathy's assignments were begun with problems initially prescribed by the teacher involving

1 digit divided by 1 digit and gradually increased in difficulty.

As a general procedure, the teacher and aide assisted students with assignments whenever help was requested, and intermittently checked the work and allowed the students to redo problems that were incorrect. According to informal teacher ratings, the students were awarded points for starting assignments, working, and generally behaving appropriately (not talking out, not getting out-of-seat without permission, not disturbing others, etc.). These points were redeemable at the end of the week for prizes. In addition, free time, candy favors, verbal praise and behavior-specific feedback were provided on an unsystematic basis for appropriate behavior. This system was ongoing throughout the study and across all periods.

Experimental Design

The study employed a combination multiple-baseline and reversal design to examine the effect of a peer-tutoring package on the accuracy of two students' performance of daily mathematic assignments. The peer-tutoring package, consisting of instructions, feedback on correctness, and reinforcement, was introduced sequentially for the two target students in a multiple-baseline-across-subjects design. For one target subject, Sam, treatment was later withdrawn and then reinstated in a reversal design format. This study also examined the correlated effects of treatment on two additional variables that were not directly

treated: (1) daily rates of on-task and disruptive behavior for Sam and Kathy during the treatment period; and (2) Sam's accuracy on division problems as well as his rates of on-task and disruptive behavior, during a second math period (the No Treatment Period) when no tutoring was provided, differentiated between days when the peer manager was present and those when he was out of the room.

Observation and Reliability Procedures

The primary dependent variable was the target subjects' degree of accuracy on division problems, defined as the percent of problems worked correctly of the total problems completed correctly or incorrectly. The accuracy of each daily assignment was assessed by the experimenter.

Experimental observations were conducted in the classroom of the target subjects' on-task and disruptive behaviors, teacher attention, and tutor attention. These categories were recorded by an observer upon their occurrence in continuous 15-second intervals. Definitions of the behaviors were as follows:

> On-task: The subject looks at task materials or at the teacher if she is instructing, looks for materials in desk or elsewhere in room, works with another student with permission, does not scan around the room for more than 5 consecutive seconds, and does not engage in any behavior defined in the disruptive category (see

below).

Disruptive: This behavior takes priority over other behaviors and includes talking out, talking to others without permission, tapping pencil, laughing at others, hitting others, throwing objects, etc.

Teacher Attention: Verbal comments such as instructions or praise to the subjects, or standing within one foot of the desk of the subjects.

Tutor (Manager) Attention: Helping or instructing the student to work independently. Any verbal contact is scored as H-helping, or I-instructing the student to work on his/her own.

The reliability of the accuracy measures on daily assignments was assessed frequently by comparing, problem by problem, the experimenter's records and those of the classroom teacher. A percentage of agreement was determined by dividing the total agreements by the total agreements plus disagreements and multiplying this quotient by 100. Interobserver agreement was also assessed on the behaviors recorded within the 15-sec interval system by having two observers simultaneously but independently record the behaviors. Their records were then compared interval by interval for agreement on the occurrence of each behavior. These reliability checks were conducted at least once in each experimental condition.

Experimental Conditions

Baseline: (Sam, Days 1 to 9; and Kathy, Days 26 to 30): In this condition, initial observations were conducted to determine the existing rates of the behaviors of interest. The teacher passed out assignments and outlined the tasks for the students. Intermittently, she provided assistance in working the problems and information regarding accuracy, as she had done prior to the beginning of the experiment. Upon completion of tasks, the subjects were granted free time to be used until the end of the math period. These same procedures were in effect during the No Treatment Period for all phases of the study, except in the Reversal condition, as explained on page 21.

Peer Tutoring I: (Sam, Days 10 to 21; and Kathy, Days 31 to 36): On the first day of this condition, the teacher individually asked Sam and Kathy if they would agree to receiving help on division problems from Randy during the first math period each day. Both students agreed, and the treatment package was fully explained and then introduced. A schedule was placed inside their desks, describing the time each day that they would receive help from Randy.

Randy was trained in the peer tutoring procedures during the three days prior to the first introduction of treatment for Sam. Specifically, he was instructed in the delivery of positive comments (That's good work, etc.) for increasing desired behaviors and in awarding points systematically for correct work. The experimenter acted as the target child in a role playing situation with Randy in order to provide a

more realistic example of expected behavior. Thirty-minute sessions were conducted for three successive days after school activities had been completed, during which Randy learned to successfully administer the contingency system. Randy was told to withhold treatment during other periods of the day and to assist Sam (and, later, Kathy) only during the first math session each day, designated as the Treatment Period. If either Sam or Kathy requested assistance during the No Treatment Period, Randy was to tell them to work on their own. The teacher and aide provided help during this time as they had done prior to the study.

At the beginning of each treatment period, the subjects were handed their assignments by the teacher and told that they would receive help working problems from Randy, plus one minute of free time for each problem worked correctly. The assignments consisted of 12 problems, with the first two being examples. The remaining 10 problems were divided into 2 units of 5 problems each. This differed from Baseline assignments in that previous assignments were not divided into specific work units. Randy assisted Sam and Kathy individually with examples (if they needed help) and returned to his own work. They were then to work independently until the first unit was completed, when the peer manager would grade the problems and provide verbal praise and instructional feedback. The target students reworked incorrect problems and continued with the second unit following the same procedure. They were told their work was not timed, and they would have the full time allotted for that period. When the target students

completed the assignment (or as many problems as they could in the allotted time), the peer manager awarded one minute of free time for each correctly worked problem.

The peer manager was provided with the answers to the problems to facilitate a quicker and more accurate grading process. The manager gave the target student credit for only the problems worked independently and was not allowed to provide explicit answers; rather he assisted the student in arriving at the answers through specific instructions. After each session, the manager was praised for appropriate behavior by the experimenter. He was allowed to participate only if he kept up with his own work. The treatment package, using the peer manager to provide tutorial assistance and administer a reinforcement system, was generally the same as the procedures used by the teacher during Baseline; however, during treatment, Randy was able to provide assistance and reinforcement on a more systematic basis, since he was not distracted by the demands of other students.

Reversal: (Sam, Days 22 to 30): On Day 22, the peer tutoring package with Sam was withdrawn. Randy was now instructed to refrain from assisting Sam on the division problems, and the teacher returned to helping and providing reinforcement to Sam for his math work as in the Baseline condition. In addition, free time was now awarded upon completion of his assignment rather than on the basis of correct performance on math problems.

At the point indicated by the arrow (Day 28), the reversal procedures were changed such that the teacher no longer

attended to Sam after giving the initial instructions; and thus Sam received no help or feedback on his work during this period. He did, however, receive free time upon completing his assignment. For the three days these revised reversal procedures were in effect in the Treatment Period, the same procedures were implemented (inadvertently) in the No Treatment Period as well; this is the only occasion when any special procedures were instituted in the No Treatment Period.

Peer Tutoring II: (Sam Days 31 to 36): The peer tutoring package was reintroduced for Sam for the six days of this condition. The procedures were the same as during the first Peer Tutoring condition.

Results

Reliability Results:

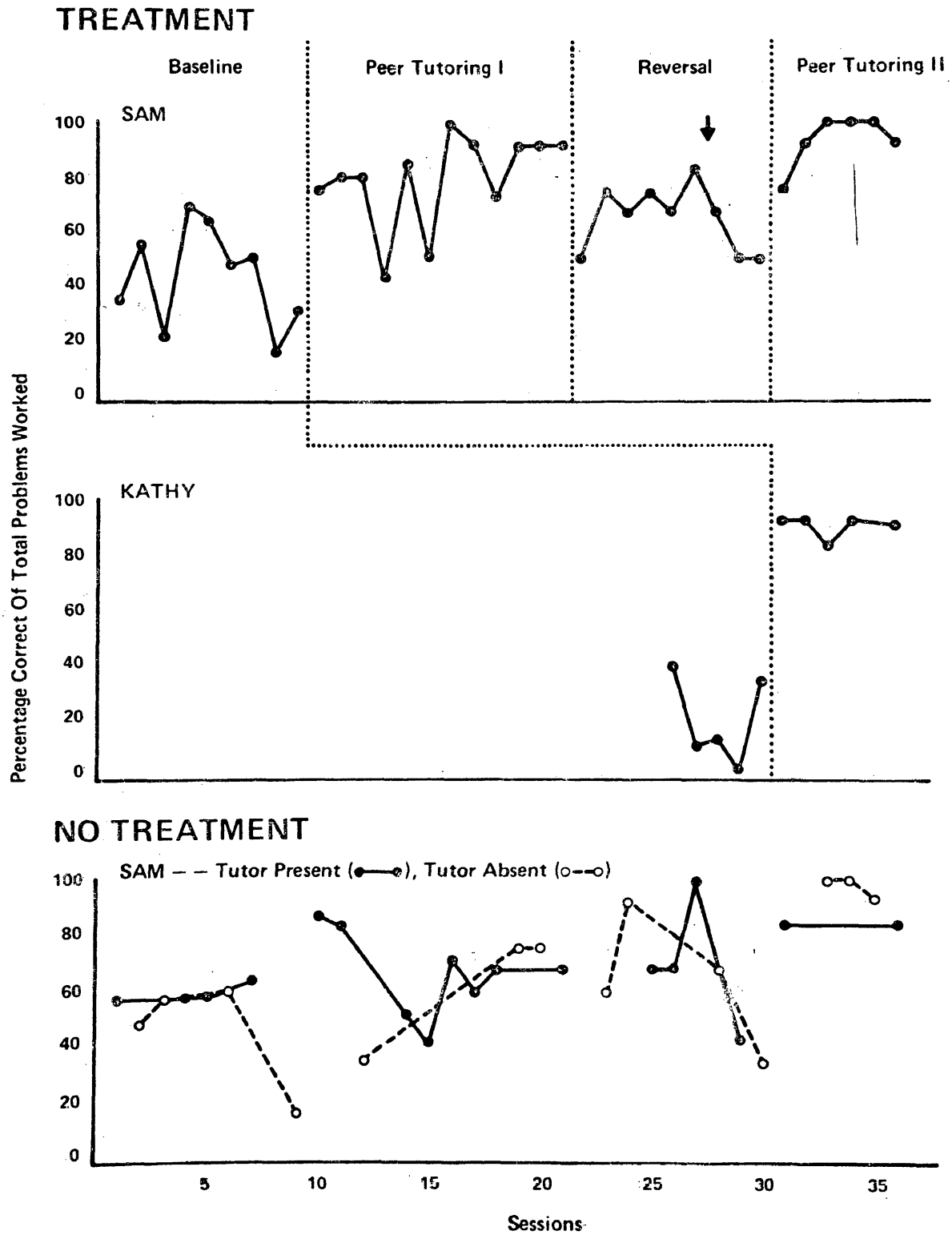
The ranges and means of reliabilities for defined behaviors are presented in Tables 1 and 2. The average reliability for any one behavior across the entire study ranged from 72% to 100%.

Insert Tables 1 and 2 Here

Peer Tutoring Results:

Figure 1 illustrates the subjects' daily levels of accuracy on mathematics assignments. The top two graphs depict the students' accuracy during the first daily math period, the Treatment Period; the bottom graph presents

Figure 1. Daily levels of correctly worked mathematics problems as a percentage of total problems worked. Accuracy measures during the Treatment Period are presented for both target students (top and middle graphs), and during the No Treatment Period for only one student (bottom graph). Dotted vertical lines denote changes in experimental conditions. The arrow on the top graph indicates the point at which teacher attention was withdrawn in the Reversal condition.


TREATMENT
Baseline
Peer Tutoring I
Reversal
Peer Tutoring II
SAM
KATHY
100
80
60
40
20
0
Percentage Correct Of Total Problems Worked
NO TREATMENT
SAM – – Tutor Present (●—●), Tutor Absent (o--o)
5
10
15
20
25
30
35
Sessions

Sam's rate of accuracy in the second math period, the No Treatment Period. In the first math period, Sam averaged 43% accuracy during Baseline, ranging from 15 to 69%. After Peer Tutoring I was introduced, a significant increase was seen in his level of accuracy, to a mean of 79%. Two extremely low points during Peer Tutoring I should be explained. On Day 13, his percentage dropped to 42% because he did not follow instructions and worked several problems incorrectly. On Day 15, he performed poorly after using his free time prior to the math period to take a nap, which left him groggy and lethargic during the math period. Later treatment sessions indicate higher and steadier rates of performance. On Day 22, the treatment package was withdrawn and Baseline conditions were reinstated. Sam's accuracy dropped initially, but then increased to an average of 70% for the first six days of the condition. This rate was well below his performance during the latter days of Peer Tutoring I, but was not as low as in the original Baseline condition, and appeared to be holding steady or increasing. At the point denoted by the arrow, the procedures for the Reversal condition were altered such that all teacher attention was withdrawn after the initial instructions for the math assignment. This change resulted in a further drop in accuracy to an average level of 56%. With reinstatement of treatment on Day 31, a sharp increase in rate of accuracy was observed, to an average of 93%.

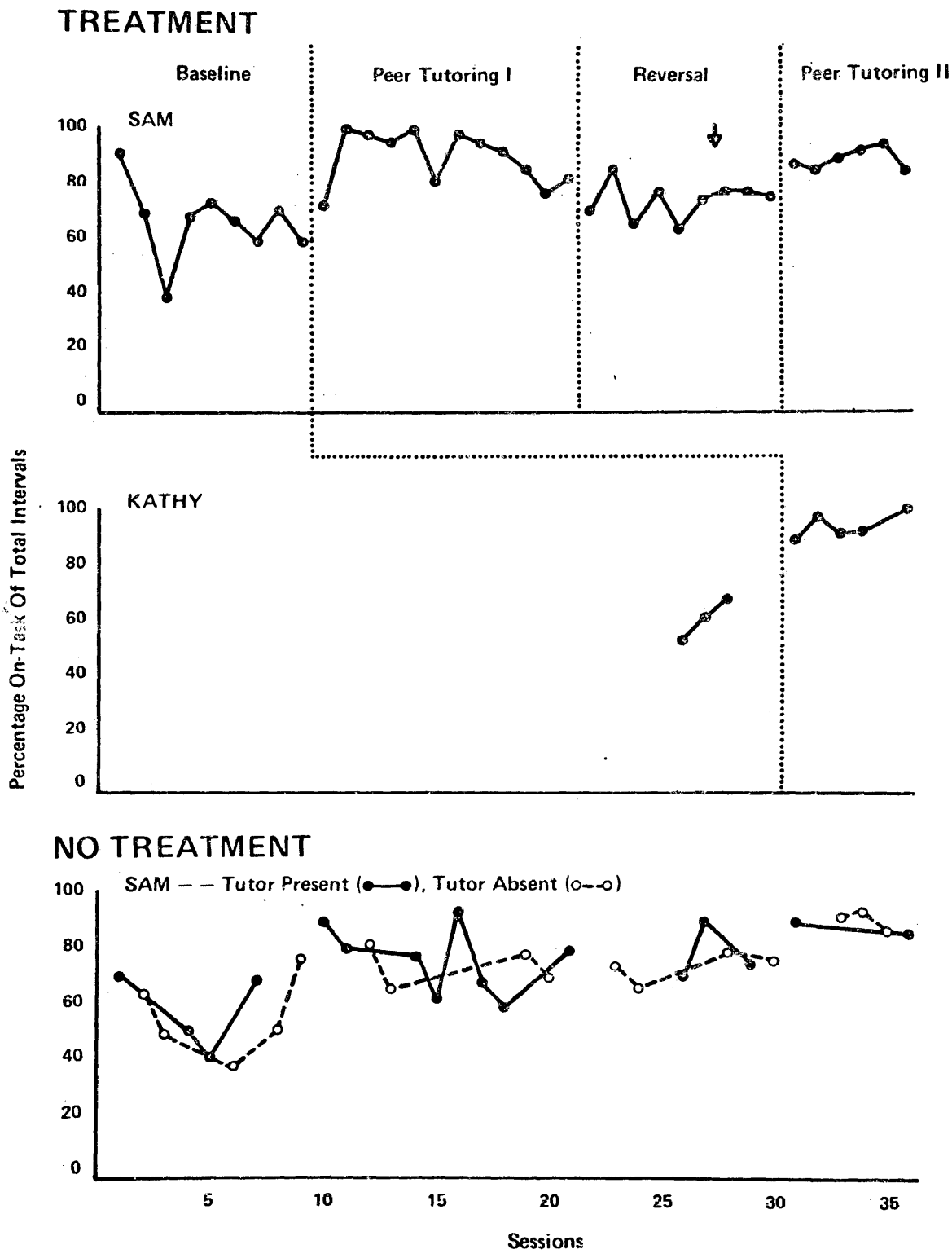
Kathy's rate of accuracy during Baseline was very low,

averaging 18%. Instatement of treatment on Day 31 resulted in marked change in her performance on division problems to a mean rate of 90% accuracy.

The third graph on Figure 1 illustrates Sam's accuracy rate during the No Treatment Period, correlated with each experimental condition in the Treatment Period. This graph shows variable rates of accuracy, with a gradual increase in the mean accuracy levels across conditions, both in the presence and absence of the tutor. Specifically, the mean accuracy percentages across successive conditions for tutor presence were 57, 65, 69, and 83, and for tutor absence, 43, 61, 63, and 97. Withdrawal of peer tutoring in the Treatment Period was not correlated with a drop in the accuracy rate for Sam during the No Treatment Period until Day 28, when teacher attention was withdrawn in both the Treatment and No Treatment Periods; however, a substantial improvement in accuracy was seen when the peer-tutoring package was reinstated during the Treatment Period.

Figure 2 presents the subjects' levels of on-task behavior during the math periods(s), as a percentage of total 15-second intervals observed. During Baseline conditions for the Treatment Period, Sam's on-task behavior average 66%; following the introduction of Peer Tutoring I, his rate of on-task behavior increased to 89%, even though this behavior was not directly consequated. During the Reversal phase, Sam's level of on-task behavior dropped somewhat, to a mean of 74%, and then increased with the reintroduction of

Figure 2. Daily levels of on-task behavior as a percentage of total intervals observed for Sam (during both the Treatment and No Treatment Periods) and Kathy (only during the Treatment Period). Dotted vertical lines denote changes in experimental conditions. The arrow on the top graph indicates the point at which teacher attention was withdrawn in the Reversal condition.

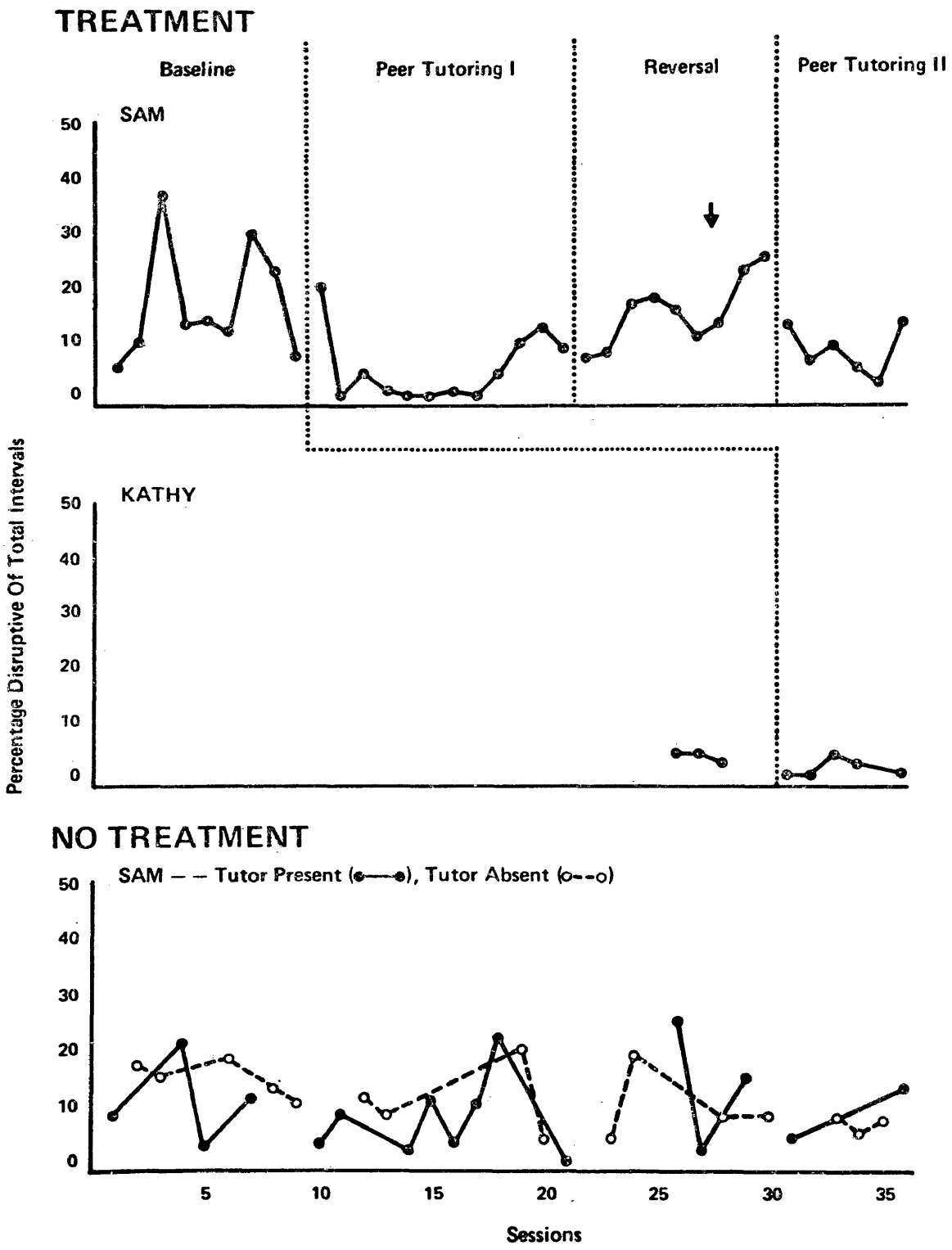

TREATMENT
Baseline
Peer Tutoring I
Reversal
Peer Tutoring II
SAM
KATHY
100
80
60
40
20
0
Percentage On-Task Of Total Intervals
NO TREATMENT
SAM — — Tutor Present (●—●), Tutor Absent (○--○)
5
10
15
20
25
30
35
Sessions

treatment to an average of 89%. Kathy also showed an increase in on-task behavior during treatment on division skills. The pretreatment level of on-task behavior for Kathy averaged 60%, with 94% after treatment was introduced; however, there appears to have been an increasing trend which may have occurred without the treatment procedure. Two data points (Days 29 and 30) are missing for Kathy on Figures 2, 3, and 4. Observations of correlated behaviors were not taken on these days, only accuracy measures.

The third graph on Figure 2 indicates that systematic increases in Sam's on-task behavior occurred during the No Treatment Period, corresponding with the beginning of Peer Tutoring conditions I and II, with the maintenance of steady on-task performance during the Reversal condition. No differential effects were observed in on-task performance between the tutor's presence and absence. The mean on-task percentages across successive conditions in the tutor's presence were 56, 75, 78, and 87, and in the tutor's absence 54, 73, 73, and 90.

Daily levels of disruptive behavior are illustrated in Figure 3 for both target subjects. Sam's disruptive behavior exhibited a mean rate of 17% prior to treatment, which then dropped to 5% during Peer Tutoring I. The Reversal phase resulted in a rise in disruptive behavior to an average of 15%, but reintroduction of treatment led to a reduction in undesirable behaviors back to 8%. Kathy's level of disruptive behavior remained very low during both Baseline and Peer Tutoring conditions, at averages of 3 and 2%, respectively.

Figure 3. Daily levels of disruptive behavior as a percentage of total intervals observed for Sam (during both the Treatment and No Treatment Periods) and Kathy (only during the Treatment Period). Dotted vertical lines denote changes in experimental conditions. The arrow on the top graph indicates the point at which teacher attention was withdrawn in the Reversal condition.

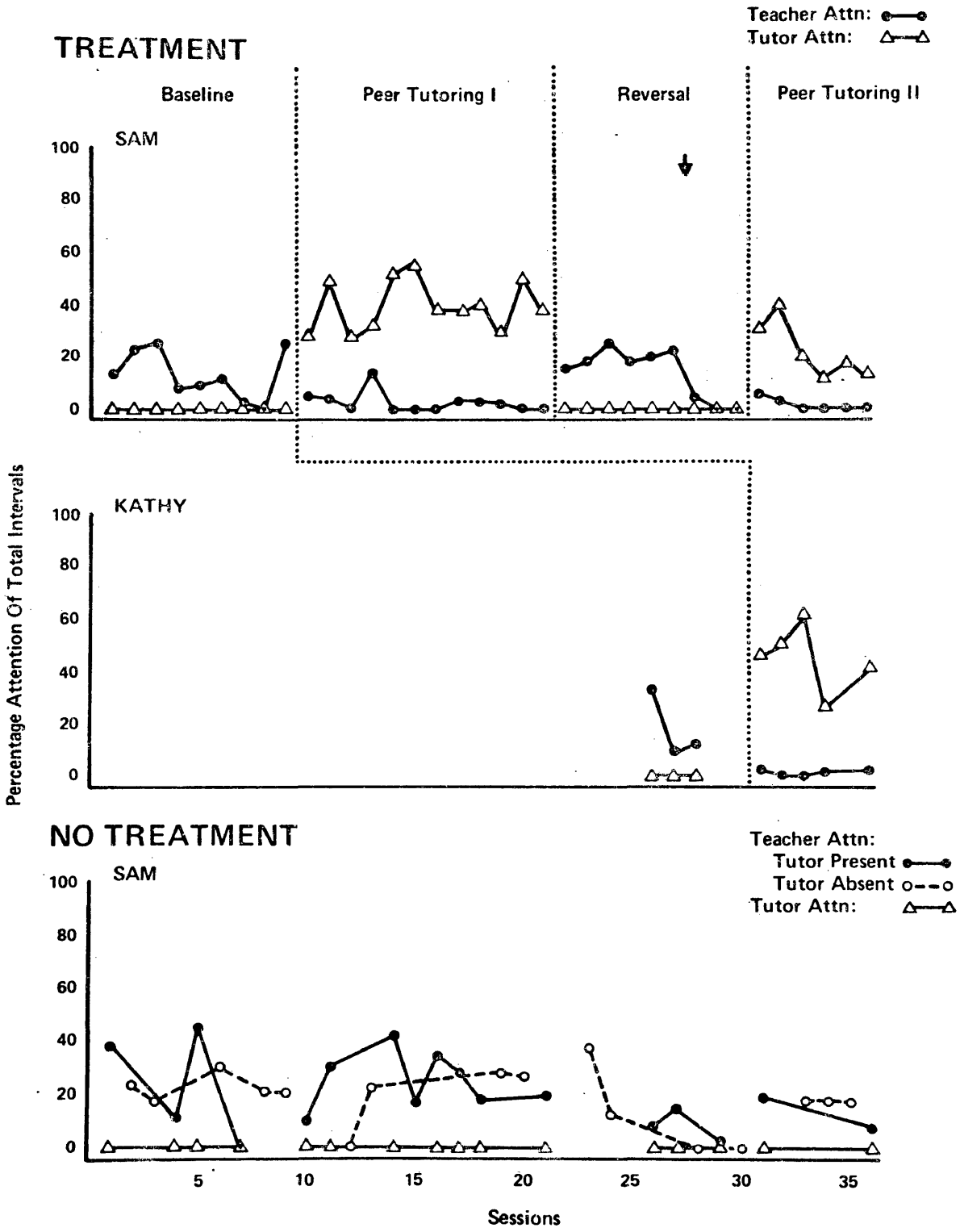

TREATMENT
Baseline
Peer Tutoring I
Reversal
Peer Tutoring II
SAM
KATHY
50
40
30
20
10
0
Percentage Disruptive Of Total Intervals
NO TREATMENT
SAM — — Tutor Present (●—●), Tutor Absent (o--o)
5
10
15
20
25
30
35
Sessions

The third graph in Figure 3 indicates a relatively steady, low rate of disruptive behavior during the No Treatment Period across the study, with no systematic changes associated with experimental conditions or with the presence or absence of the peer tutor.

Figure 4 illustrates the levels of teacher and tutor attention provided to the subjects for each condition as a percentage of total observation intervals. The Baseline teacher attention rate for Sam averaged 13%, with a significant drop to only 3% during Peer Tutoring I. The Reversal phase showed an increase in teacher attention to a mean of 20% for the first 6 days (until teacher attention was reduced to a mean of 1% for the days following the point indicated by the arrow), and only 2% during Peer Tutoring II. Tutor attention, which occurred only during treatment phases, averaged 40% in Peer Tutoring I and 22% in Peer Tutoring II for Sam and 45% in Peer Tutoring I for Kathy. During the No Treatment Period, the level of teacher attention for Sam showed little change, except in the latter portion of the Reversal condition, when teacher attention was reduced to virtually a zero rate for the final three days. As the study reached the final days, Sam began to work more on his own and thus required less attention from both the teacher and tutor.

Additional measures recorded during the No Treatment Period were instances of interaction between Sam and Randy when the tutor remained in the room. There were two instances

Figure 4. Daily levels of teacher and tutor attention as percentages of total intervals observed for Sam (during both the Treatment and No Treatment Periods) and Kathy (only during the Treatment Period). Dotted vertical lines denote changes in experimental conditions. The arrow on the top graph indicates the point at which teacher attention was withdrawn in the Reversal condition.


TREATMENT
Teacher Attn:
Tutor Attn:
Baseline
Peer Tutoring I
Reversal
Peer Tutoring II
SAM
KATHY
100
80
60
40
20
0
Percentage Attention Of Total Intervals
NO TREATMENT
Teacher Attn:
Tutor Present
Tutor Absent
Tutor Attn:
SAM
5
10
15
20
25
30
35
Sessions

of the target subject Sam requesting help with the problems, and he was told by the tutor to work independently. This measure indicates that the tutor followed the teacher's instructions by not generalizing his tutoring activities into the following period.

Discussion

The purposes of this study were to (1) examine changes in the levels of accuracy on division problems for two subjects through the implementation of a peer-tutoring package; (2) to examine changes in on-task and disruptive behavior for the target subjects correlated with improvements in accuracy; and (3) to test for generalized changes in accuracy, on-task, and disruptive behavior for one student during a No Treatment Period. The following paragraphs discuss the extent to which these goals were achieved in the present research.

The results indicate desired changes in accuracy rates across both target subjects, who had functioned well below satisfactory levels during Baseline conditions. Introduction of the treatment package led to an immediate improvement in accuracy across the two subjects Sam and Kathy, thus suggesting that the procedure was effective in accelerating rates of performance. Withdrawal of the program led to a decrement in correct responding for Sam with a recovered high rate of performance after reinstatement. The withdrawal of treatment for Sam on Day 22 did not result in depressed accuracy rates comparable to those during Baseline. Rather, his performance levels fell in between Baseline and Peer Tutoring I

levels. Teacher attention during the Reversal changed from Baseline in that it was more frequent, and also appeared to be more positive. Sherman and Cormier (1974) modified student behaviors without teacher knowledge and found the teacher's reactions toward the students were more positive as the students increased appropriate behaviors. Since this behavior of the teacher had perhaps maintained Sam's higher levels of performance, teacher attention was withdrawn beginning on Day 28 and continued until Peer Tutoring II. Another possible explanation for the failure to exactly replicate Baseline levels of performance may have been in the nature of the task. Ulman and Sulzer-Azaroff (1975) warn experimenters of the non-reversibility of some learning phenomena because the subject may master the task and continue to perform at higher rates even after withdrawal of treatment.

Although this study was successful in changing student behaviors using a peer-tutoring package, it was not determined which particular aspects of the package were responsible for these changes. Possibly tutor attention would have been sufficient to improve performance without the change in reinforcement contingencies; or, perhaps making free time contingent on correctness rather than work completion was a crucial variable. Harris and Sherman (1973a) found consequences for accuracy enhanced the effectiveness of their tutored math sessions.

Observations of additional student behaviors show an acceleration in on-task behavior and lower levels of disruptive behavior correlated with implementation of the

peer-tutoring package. Although these behaviors were not directly consequated, a direct relationship apparently existed between desired student behaviors and academic performance. Ayllon and Roberts (1974) found that disruptive behaviors decreased as a result of reinforcing academic behaviors using the teacher as an agent of reinforcement. Conversely, Ferritor, et. al. (1972) found disruptive behaviors to increase and attending behaviors to decrease when they reinforced only correct work. They also used the classroom teacher as the reinforcing agent. Perhaps a peer can be more effective in providing approval and consistent in dispensing rewards. Few studies using peer tutors have attempted to correlate student behaviors of target subjects with improved academics. Surratt, et. al. (1969) reinforced "working behavior" in students and assumed their study improved academic accomplishment, but no measures were documented of student progress, rather teacher's anecdotal remarks were used to support their assumptions.

In addition to improved accuracy rates and correlated behaviors during the Treatment Period, improvements were seen in Sam's behavior during the No Treatment Period. He generalized his increased levels of accuracy over a second period in which no contingencies were placed on his behavior. Even though on-task and disruption were not consequated during the No Treatment Period, improvements were seen in on-task behavior also. Stokes and Baer (1976b) and Johnston

and Johnston (1972) found peers to possess discriminative properties in that their presence in settings other than the experimental setting facilitated generalization. Surratt, et. al. (1969) report their target subjects showed sudden improvements in working activities during a post check when the reinforcing peer was returned to the classroom. The present study examined the target Sam's behaviors during the No Treatment Period in the presence and absence of the peer tutor without finding significant differences in his performance under these two conditions. The setting remained the same as during the experimental period, i.e., the teacher, pupils and classroom all remained the same, which should facilitate generalization. Previous studies have used younger subjects (Johnston & Johnston, 1972; Stokes & Baer, 1976b) to examine discriminative properties of peers. Older subjects may be more self motivated and not rely on cueing by others. Also, the nature of the task may determine to what extent generalization is observed. The task in the present study was a more concrete assignment requiring the subject to calculate and formulate answers which may in itself be reinforcing enough, especially with immediate and tangible feedback (points redeemable for free-time). It is possible that he mastered the task and established his own criteria for performance during the No Treatment Period. Also, as previously mentioned, teacher attention appeared to be more positive because of the change in the target's behavior and she may have assisted in sustaining desirable rates of behavior.

Whereas many studies in school classrooms introduce new procedures to facilitate behavior change, the present study focused on rearranging aspects of the existing classroom routine to provide more systematic control of desired behaviors. For example, the peer manager had previously assisted some of the other students with assignments, free-time had been awarded for appropriate behaviors, and the students had received behavior-specific feedback and praise for their work. During the study, the peer manager was trained to instruct the targets rather than the teacher. He was able to devote more time systematically since he was not distracted by other students requesting assistance. Free-time was made contingent on accuracy rather than being awarded upon completion of assignment. Sam may have received less free-time during treatment than previously. Prior to the treatment, he was allowed free-time upon completion of assignment to be used until the end of the period. He would typically complete an assignment very hurriedly without regard for accuracy. However, with the free-time awarded during the treatment procedure, he was able to save up his earned minutes and spend them at a time of his choosing. Thus, this study attempted to take advantage of existing classroom procedure and put them to more efficient use.

Treatment appeared to foster positive socialization between students. Previously, most of their contacts had been negative with little positive interaction. After the

treatment was begun with Sam, he and Randy worked together on a science project. Randy's interaction with other students became more positive and he encouraged students with remarks such as, "You're doing a good job," rather than, "You don't know how to do things right".

Anecdotal observations of the two target subjects indicated an improvement in attitudes about their abilities to perform on the division problems. At the onset of the treatment, Sam was overheard to say "I can't do these problems. They're too hard. I'm dumb." Randy encouraged him to work the problems by himself and he was able to earn an accuracy level of 79% during Peer Tutoring I and 93% during Peer Tutoring II. Sam began the program with simple single digit divisor and three digit dividends and improved his proficiency to double divisors with four digit dividends. Kathy went from single digit divisors and dividends to single digit divisors with three digit dividends in a ten day period.

During the second treatment condition, Sam had requested assistance in the No Treatment Period from the teacher aide, but then apparently changed his mind and said, "I want to work these problems by myself". Several times he commented to the other students, "Be quiet so I can do my work". Many times he was the only student working while the others were involved in arguing. Kathy remarked on the first day of treatment, "I finally understand this". This is not to say that the teacher instructions were inadequate,

as the teacher and her aide made a considerable effort to assist the target students with their work. Rather, the peer-tutoring procedure provided more frequent and consistent help and reinforcement than was feasible for the teacher to provide, and thus increased the overall instructional input to the target subjects.

Teacher time was reduced during the treatment procedure so that she was able to devote more time to other students. Randy spent more time than the teacher with each of the targets according to the observer's recordings. However, most of the time recorded as tutor attention was spent in grading the problems rather than instruction. He was able to maintain his academic standing and did not fall behind. The managerial position was apparently very reinforcing for him, because during the Reversal condition he asked several times when he would be able to assist Sam again. The teacher reported that he seemed much more interested in his own school work during peer-tutoring conditions.

Future research utilizing peers in the classroom to improve academic skills should examine to what extent these improvements enhance students behaviors. This study did not find a significant difference in target performance during the No Treatment Period between the two conditions differentiated by the presence or absence of the peer-tutor. However, the nature of the task, age of the subjects, similarity of the settings, and short time between periods could have been more influential in promoting a sustained response in

the present study than in others.

This study was not able to examine the peer-tutor's benefits from the study, but Siegel and Steinman (1975) found a vicarious effect responsible for increases in the peer tutor's on-task behaviors as a result of seeing another student being reinforced. The implications for future research are extensive regarding the beneficial aspects possible for each student involved.

References

Ayllon, T., & Roberts, M. D. Eliminating discipline problems by strengthening academic performance. Journal of Applied Behavior Analysis, 1974, 7, 71-76.

Bailey, J. S., Timbers G. D., Phillips, E. L., & Wolf, M. M. Modification of articulation errors of predelinquents by their peers. Journal of Applied Behavior Analysis, 1971, 4, 257-339.

Barrish, H. H., Saunders, M., & Wolf, M. Good behavior game: Effects of individual contingencies for group consequences on disruptive behavior in a classroom. Journal of Applied Behavior Analysis, 1969, 2, 119-124.

Broden, M., Bruce, C., Mitchell, M. A., Carter, V., & Hall, R. Effects of teacher attention on attending behavior of two boys at adjacent desks. Journal of Applied Behavior Analysis, 1970, 3, 119-203.

Chadwick, B. A., & Day, R. C. Systematic reinforcement: Academic performance of underachieving students. Journal of Applied Behavior Analysis, 1971, 4, 311-319.

Clark, H. B., Rowbury, T., Baer, A. M., & Baer, D. M. Timeout as a punishing stimulus in continuous and intermittent schedules. Journal of Applied Behavior Analysis, 1973, 6, 443-455.

Ferritor, D. E., Buckholdt, D., Hamblin, R. L., & Smith, L. The noneffects of contingent reinforcement for attending behavior on work accomplished. Journal

of Applied Behavior Analysis, 1972, 5, 7-17.

Hall, R. V., Panyan, M., Rabon, D., & Broden, M. Instructing beginning teachers in a reinforcement procedures which improve classroom control. Journal of Applied Behavior Analysis, 1968, 1, 315-322.

Harris, V. W., & Sherman, J. A. Effects of peer tutoring and consequences on the math performance of elementary classroom students. Journal of Applied Behavior Analysis, 1973a, 6, 587-597.

Harris, V. W., & Sherman, J. A. Use and analysis of the "good behavior game" to reduce disruptive classroom behavior. Journal of Applied Behavior Analysis, 1973b, 6, 405-417.

Johnston, J. M., & Johnston, G. T. Modification of consonant speech-sound articulation in young children. Journal of Applied Behavior Analysis, 1972, 5, 233-246.

Jones, F. H., & Eimers, R. C. Role playing to train elementary teachers to use a classroom management "skill package." Journal of Applied Behavior Analysis, 1975, 8, 421-433.

Lahey, B. B., McNees, M. P., & McNees, M. C. Control of an obscene "verbal tic" through timeout in an elementary school classroom. Journal of Applied Behavior Analysis, 1973, 6, 101-104.

Long, J., & Madsen, C. Five-year-olds as behavioral engineers for younger students in a day-care center.

In E. Ramp and G. Semb (Eds.) Behavior Analysis: Areas of Research and Application. Englewood Cliffs, N. J.: Prentice-Hall, 1975, 341-351.

Lovitt, T. C., & Curtis, K. A. Academic response rate as a function of teacher and self-imposed contingencies. Journal of Applied Behavior Analysis, 1969, 2, 49-53.

Lovitt, T., Lovitt, A., Eaton, M., & Kirkwood, M. The deceleration of inappropriate comments by a natural consequence. Journal of School Psychology, 1973, 2, 148-156.

Medland, M. B., & Stachnik, J. J. Good-behavior game: A replication and systematic analysis. Journal of Applied Behavior Analysis, 1972, 5, 45-51.

O'Leary, K. D., Becker, W. C., Evans, M. B., & Saundergas, R. A. A token reinforcement program in a public school: A replication and systematic analysis. Journal of Applied Behavior Analysis, 1969, 2, 3-13.

Osborne, J. G. Free-time as a reinforcer in the management of classroom behavior. Journal of Applied Behavior Analysis, 1969, 2, 113-118.

Packard, R. G. The control of "classroom attention": A group contingency for complex behavior. Journal of Applied Behavior Analysis, 1970, 3, 13-28.

Sherman, T. M., & Cormier, W. H. An investigation of student behavior on teacher behavior. Journal of Applied Behavior Analysis, 1974, 7, 11-21.

Siegel, L. J., & Steinman, W. M. The modification of a peer-observer's classroom behavior as a function of his serving as a reinforcing agent. In E. Ramp and G. Semb (Eds.) Behavior Analysis: Areas of Research and Application. Englewood Cliffs, N. J.: Prentice-Hall, 1975, 341-356.

Solomon, R. W., & Wahler, R. G. Peer reinforcement control of classroom problem behavior. Journal of Applied Behavior Analysis, 1973, 6, 49-56.

Stokes, T. F., & Baer, D. M. An implicit technology of generalization. Journal of Applied Behavior Analysis, 1976a (in press).

Stokes, T. F., & Baer, D. M. Preschool peers as mutual generalization-facilitating agents. Behavior Therapy, 1976b, 7, 549-556.

Surratt, P. R., Ulrich, R., & Hawkins, R. An elementary student as a behavioral engineer. Journal of Applied Behavior Analysis, 1969, 2, 85-92.

Thomas, D. R., Becker, W. C., & Armstrong, M. Production and elimination of disruptive classroom behavior by systematically varying teacher's behavior. Journal of Applied Behavior Analysis, 1968, 1, 35-45.

Tucker, S., & Wheeler, J. Mathematics Laboratory. Cincinnati, Ohio: McCormick-Mathers Publishing Company, Inc., 1970.

Ulman, J. D., & Sulzer-Azaroff, B. Multielement baseline design in educational research. In E. Ramp and G.

Semb (Eds.) Behavior Analysis: Areas of Research and Application. Englewood Cliffs, N. J.: Prentice-Hall, 1975, 377-391.

Wasik, B. H., Senn, K., Welch, R. H., & Cooper, B. R. Behavior modification with culturally deprived school children: Two case studies. Journal of Applied Behavior Analysis, 1969, 2, 181-194.

Williams, R. L., & Anandam, K. The effect of behavior contracting on grades. Journal of Educational Research, 1973, 66, 230-236.

Table 1

Reliability Percentages for Sam

Behavior	Setting*	Range of Mean Reliabilities Within Conditions	Mean Reliability Across All Conditions
Accuracy	1	92-100	96
	2	---	100
	3	---	100
On-task	1	87-100	93
	2	89- 93	93
	3	78- 87	84
Disruptive	1	60-100	73
	2	50-100	72
	3	70-100	83
Teacher Attention	1	67-100	90
	2	75-100	90
	3	38-100	72
Tutor Attention	1	84- 92	88
	2	---	---
	3	---	---

* Setting 1--Treatment Period; Setting 2--No Treatment Period with tutor present; Setting 3--No Treatment Period with tutor absent.

Table 2

Reliability Percentages for Kathy

Behavior	Range of Mean Reliabilities Within Conditions	Mean Reliability Across All Conditions
Accuracy	---	100
On-task	96-100	98
Disruptive	---	100
Teacher Attention	---	100
Tutor Attention	92-100	96